

WHAT IS CLAIMED IS:

1. A luminescent device:  
comprising an organic luminescent element comprising:  
5                   an anode;  
                  a cathode; and  
                  a hole transporting layer provided between the anode and the cathode,  
comprising a first compound and a second compound;  
                  wherein the first compound is smaller in ionization potential than the second  
10 compound, and  
                  wherein the second compound is larger in hole mobility than the first compound.
2. A luminescent device according to claim 1, wherein there is a concentration  
gradient that a concentration of the first compound is decreased toward the cathode from  
15 the anode and a concentration of the second compound is increased toward the cathode  
from the anode.
3. A luminescent device according to claim 1, wherein the first compound  
comprises a phthalocyanine compound.
- 20                   4. A luminescent device according to claim 1, wherein the second compound  
comprises an aromatic amine-based compound.
5. A luminescent device according to claim 1, wherein the organic luminescent  
25 element has a luminescence from a triplet excited state.
6. A luminescent device according to claim 1, wherein the luminescent device is  
an electric appliance selected from the group consisting of a display device, a video  
camera, a digital camera, an image reproducing device, a mobile portable computer, a  
30 personal computer, a cellular phone, and an audio.
7. A luminescent device:  
comprising an organic luminescent element comprising:  
                  an anode;

a cathode; and

an electron transporting layer provided between the anode and the cathode, comprising a first compound and a second compound;

wherein the first compound is larger in electron affinity than the second  
5 compound, and

wherein the second compound is larger in electron mobility than the first compound.

8. A luminescent device according to claim 7, wherein there is a concentration  
10 gradient that a concentration of the first compound is increased toward the cathode from the anode and a concentration of the second compound is decreased toward the cathode from the anode.

9. A luminescent device according to claim 7, wherein the first compound is  
15 selected from the group consisting of alkali metal halogenide, a metal complex having a quinoline skeleton, a metal complex having a benzoquinoline skeleton, an oxadiazole derivative, or a triazole derivative.

10. A luminescent device according to claim 7, wherein the second compound is  
20 selected from the group consisting of a metal complex having a quinoline skeleton, a metal complex having a benzoquinoline skeleton, an oxadiazole derivative, a triazole derivative, or a phenanthroline derivative.

11. A luminescent device according to claim 7, wherein the organic luminescent  
25 element has a luminescence from a triplet excited state.

12. A luminescent device according to claim 7, wherein the luminescent device  
is an electric appliance selected from the group consisting of a display device, a video camera, a digital camera, an image reproducing device, a mobile portable computer, a  
30 personal computer, a cellular phone, and an audio.

13. A luminescent device:

comprising an organic luminescent element comprising:

an anode;

a cathode; and

a luminescent layer provided between the anode and the cathode, comprising a first compound and a second compound;

wherein the first compound is larger in hole mobility than the second compound,

5 and

wherein the second compound is larger in electron mobility than the first compound.

14. A luminescent device according to claim 13, wherein there is a concentration  
10 gradient that a concentration of the first compound is decreased toward the cathode from the anode and a concentration of the second compound is increased toward the cathode from the anode.

15. A luminescent device according to claim 13, wherein the first compound  
15 comprises an aromatic amine-based compound.

16. A luminescent device according to claim 13, wherein the second compound  
is selected from the group consisting of a metal complex having a quinoline skeleton, a  
metal complex having a benzoquinoline skeleton, an oxadiazole derivative, a triazole  
20 derivative, or a phenanthroline derivative.

17. A luminescent device according to claim 13, wherein the organic  
luminescent element has a luminescence from a triplet excited state.

25 18. A luminescent device according to claim 13, wherein the luminescent device is an electric appliance selected from the group consisting of a display device, a video camera, a digital camera, an image reproducing device, a mobile portable computer, a personal computer, a cellular phone, and an audio.

30 19. A luminescent device comprising:  
an organic luminescent element comprising:

an anode;

a cathode; and

a luminescent layer provided between the anode and the cathode,

comprising a first compound, a second compound, and a third compound;

wherein the first compound is larger in hole mobility than the second compound,

wherein the second compound is larger in electron mobility than the first compound, and

5 wherein an energy difference between a highest occupied molecular orbit and a lowest unoccupied molecular orbit in the third compound is smaller than energy differences between a highest occupied molecular orbit and a lowest unoccupied molecular orbit in the first compound and the second compound.

10 20. A luminescent device according to claim 19, wherein there is a concentration gradient that a concentration of the first compound is decreased toward the cathode from the anode and a concentration of the second compound is increased toward the cathode from the anode.

15 21. A luminescent device according to claim 19, wherein the first compound comprises an aromatic amine-based compound.

20 22. A luminescent device according to claim 19, wherein the second compound is selected from the group consisting of a metal complex having a quinoline skeleton, a metal complex having a benzoquinoline skeleton, an oxadiazole derivative, a triazole derivative, or a phenanthroline derivative.

23. A luminescent device according to claim 19, wherein the organic luminescent element has a luminescence from a triplet excited state.

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24. A luminescent device according to claim 19, wherein the luminescent device is an electric appliance selected from the group consisting of a display device, a video camera, a digital camera, an image reproducing device, a mobile portable computer, a personal computer, a cellular phone, and an audio.

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25. A luminescent device comprising:  
an organic luminescent element comprising:

an anode;

a cathode;

a luminescent layer provided between the anode and the cathode; and  
a blocking layer adjacent to the luminescent layer, being provided  
between the anode and the cathode;

wherein the blocking layer comprises a blocking material and a material  
5 contained in the luminescent layer, and

wherein an energy difference between a highest occupied molecular orbit and a  
lowest unoccupied molecular orbit in the blocking material is larger than an energy  
difference between a highest occupied molecular orbit and a lowest unoccupied  
molecular orbit in a material contained in the luminescent layer.

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26. A luminescent device according to claim 25, wherein there is a concentration  
gradient that a concentration of the material contained in the luminescent layer is  
decreased toward the cathode from the anode and a concentration of the blocking  
material is increased toward the cathode from the anode.

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27. A luminescent device according to claim 25, wherein the blocking material  
is selected from the group consisting of an oxadiazole derivative, a triazole derivative, or  
a phenanthroline derivative.

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28. A luminescent device according to claim 25 wherein the organic luminescent  
element presents luminance caused from a triplet excited state.

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29. A luminescent device according to claim 25, wherein the luminescent device  
is an electric appliance selected from the group consisting of a display device, a video  
camera, a digital camera, an image reproducing device, a mobile portable computer, a  
personal computer, a cellular phone, and an audio.

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30. A luminescent device comprising:  
an organic luminescent element comprising:

an anode;

a cathode; and

an organic compound layer provided between the anode and the cathode,  
comprising a hole transporting region comprising a hole transporting material and an  
electron transporting region comprising an electron transporting material;

wherein the hole transporting region being disposed nearer to the anode than the electron transporting region, and

wherein a mixed region comprising the hole transporting material and the electron transporting material is provided between the hole transporting region and the  
5 electron transporting region.

31. A luminescent device according to claims 30, wherein there is a concentration gradient in the mixed region that a concentration of the hole transporting material is decreased toward the cathode from the anode and a concentration of the  
10 electron transporting material is increased toward the cathode from the anode.

32. A luminescent device according to claim 30, wherein a luminescent material is doped in the mixed region.

15 33. A luminescent device according to claim 30, wherein a luminescent material is doped in a portion in the mixed region.

34. A luminescent device according to claim 30, wherein a blocking material is doped in the mixed region and an energy difference between a highest occupied  
20 molecular orbit and a lowest unoccupied molecular orbit in the blocking material is larger than energy differences in the hole transporting material and in the electron transporting material.

35. A luminescent device according to claim 34, wherein the blocking material  
25 is doped in a portion of the mixed region.

36. A luminescent device according to claim 34, wherein a luminescent material and the blocking material are doped in the mixed region.

30 37. A luminescent device according to claim 36, wherein a portion added the luminescent material is disposed nearer to the anode than a portion added the blocking material.

38. A luminescent device according to one of claim 32 to 34 or one of claim 36

to 37, wherein the luminescent material presents luminance caused from a triplet excited state.

39. A luminescent device according to claim 36, wherein the ratio of a mass of the hole transporting material to the total mass of the hole transporting material and the electron transporting material in the mixed region is 10 % or more and 90 % or less.

40. A luminescent device according to claim 36, wherein the mixed region has a thickness of 10 nm or more and 100 nm or less.

41. A luminescent device according to claim 25, wherein the luminescent device is an electric appliance selected from the group consisting of a display device, a video camera, a digital camera, an image reproducing device, a mobile portable computer, a personal computer, a cellular phone, and an audio.

42. A luminescent device:

comprising an organic luminescent element comprising:

an anode;

a cathode;

a hole injecting region adjacent to the anode; and

an organic compound layer provided between the hole injecting region and the cathode, comprising a hole transporting region comprising a hole transporting material and an electron transporting region comprising an electron transporting material;

wherein the hole transporting region being disposed nearer to the anode than the electron transporting region, and

wherein a mixed region comprising the hole transporting material and the electron transporting material is provided between the hole transporting region and the electron transporting region.

43. A luminescent device according to claims 42, wherein there is a concentration gradient in the mixed region that a concentration of the hole transporting material is decreased toward the cathode from the anode and a concentration of the electron transporting material is increased toward the cathode from the anode.

44. A luminescent device according to claim 42, wherein a luminescent material is doped in the mixed region.

45. A luminescent device according to claim 42, wherein a luminescent material is doped in a portion in the mixed region.

46. A luminescent device according to claim 42, wherein a blocking material is doped in the mixed region and an energy difference between a highest occupied molecular orbit and a lowest unoccupied molecular orbit in the blocking material is larger than energy differences in the hole transporting material and in the electron transporting material.

47. A luminescent device according to claim 46, wherein the blocking material is doped in a portion of the mixed region.

48. A luminescent device according to claim 46, wherein a luminescent material and the blocking material are doped in the mixed region.

49. A luminescent device according to claim 48, wherein a portion added the luminescent material is disposed nearer to the anode than a portion added the blocking material.

50. A luminescent device according to one of claim 44 to 45 or one of claim 48 to 49, wherein the luminescent material presents luminance caused from a triplet excited state.

51. A luminescent device according to claim 48, wherein the ratio of a mass of the hole transporting material to the total mass of the hole transporting material and the electron transporting material in the mixed region is 10 % or more and 90 % or less.

52. A luminescent device according to claim 48, wherein the mixed region has a thickness of 10 nm or more and 100 nm or less.

53. A luminescent device according to claim 42, wherein the luminescent device



is an electric appliance selected from the group consisting of a display device, a video camera, a digital camera, an image reproducing device, a mobile portable computer, a personal computer, a cellular phone, and an audio.

5           54. A luminescent device comprising:  
an organic luminescent element comprising:

an anode;  
a cathode;  
an electron injecting region contacted with the cathode; and

10           an organic compound layer provided between the anode and the  
electron injecting region, comprising a hole transporting region comprising a hole  
transporting material and an electron transporting region comprising an electron  
transporting material;

15           wherein the hole transporting region being disposed nearer to the anode than the  
electron transporting region, and

wherein a mixed region comprising the hole transporting material and the  
electron transporting material is provided between the hole transporting region and the  
electron transporting region.

20           55. A luminescent device according to claims 54, wherein there is a  
concentration gradient in the mixed region that a concentration of the hole transporting  
material is decreased toward the cathode from the anode and a concentration of the  
electron transporting material is increased toward the cathode from the anode.

25           56. A luminescent device according to claim 54, wherein a luminescent material  
is doped in the mixed region.

57. A luminescent device according to claim 54, wherein a luminescent material  
is doped in a portion in the mixed region.

30           58. A luminescent device according to claim 54, wherein a blocking material is  
doped in the mixed region and an energy difference between a highest occupied  
molecular orbit and a lowest unoccupied molecular orbit in the blocking material is  
larger than energy differences in the hole transporting material and in the electron

transporting material.

59. A luminescent device according to claim 58, wherein the blocking material is doped in a portion of the mixed region.

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60. A luminescent device according to claim 58, wherein a luminescent material and the blocking material are doped in the mixed region.

61. A luminescent device according to claim 60, wherein a portion added the luminescent material is disposed nearer to the anode than a portion added the blocking material.

62. A luminescent device according to one of claim 56 to 57 or one of claim 60 to 61, wherein the luminescent material presents luminance caused from a triplet excited state.

63. A luminescent device according to claim 60, wherein the ratio of a mass of the hole transporting material to the total mass of the hole transporting material and the electron transporting material in the mixed region is 10 % or more and 90 % or less.

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64. A luminescent device according to claim 60, wherein the mixed region has a thickness of 10 nm or more and 100 nm or less.

65. A luminescent device according to claim 54, wherein the luminescent device is an electric appliance selected from the group consisting of a display device, a video camera, a digital camera, an image reproducing device, a mobile portable computer, a personal computer, a cellular phone, and an audio.

66. A luminescent device comprising:  
an organic luminescent element comprising:

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- an anode;
- a cathode;
- a hole injecting region adjacent to the anode;
- an electron injecting region adjacent to the cathode; and

an organic compound layer provided between the hole injecting region and the electron injecting region, comprising a hole transporting region comprising a hole transporting material and an electron transporting region comprising an electron transporting material;

5 wherein the hole transporting region is disposed nearer to the anode than the electron transporting region, and

wherein a mixed region comprising the hole transporting material and the electron transporting material is provided between the hole transporting region and the electron transporting region.

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67. A luminescent device according to claims 66, wherein there is a concentration gradient in the mixed region that a concentration of the hole transporting material is decreased toward the cathode from the anode and a concentration of the electron transporting material is increased toward the cathode from the anode.

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68. A luminescent device according to claim 66, wherein a luminescent material is doped in the mixed region.

69. A luminescent device according to claim 66, wherein a luminescent material  
20 is doped in a portion in the mixed region.

70. A luminescent device according to claim 66, wherein a blocking material is doped in the mixed region and an energy difference between a highest occupied molecular orbit and a lowest unoccupied molecular orbit in the blocking material is  
25 larger than energy differences in the hole transporting material and in the electron transporting material.

71. A luminescent device according to claim 70, wherein the blocking material is doped in a portion of the mixed region.

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72. A luminescent device according to claim 70, wherein a luminescent material and the blocking material are doped in the mixed region.

73. A luminescent device according to claim 72, wherein a portion added the

luminescent material is disposed nearer to the anode than a portion added the blocking material.

74. A luminescent device according to one of claim 69 to 70 or one of claim 72 to 73, wherein the luminescent material presents luminance caused from a triplet excited state.

75. A luminescent device according to claim 72, wherein the ratio of a mass of the hole transporting material to the total mass of the hole transporting material and the electron transporting material in the mixed region is 10 % or more and 90 % or less.

76. A luminescent device according to claim 72, wherein the mixed region has a thickness of 10 nm or more and 100 nm or less.

77. A luminescent device according to claim 66, wherein the luminescent device is an electric appliance selected from the group consisting of a display device, a video camera, a digital camera, an image reproducing device, a mobile portable computer, a personal computer, a cellular phone, and an audio.

78. A luminescent device comprising:  
an organic luminescent element comprising:  
an anode;  
a cathode; and  
an organic compound layer provided between the anode and the cathode,  
comprising a hole transporting region comprising a hole transporting material and an electron transporting region comprising an electron transporting material;  
wherein a mixed region is provided between the hole transporting region and the electron transporting region, comprising the hole transporting material and the electron transporting material,  
wherein a luminescent region added a luminescent material is provided in the mixed region.

79. A luminescent device according to claim 78, wherein the mixed region comprises the hole transporting material and the electron transporting material at a

constant ratio.

80. A luminescent device according to claim 78, wherein the luminescent region is a part of the mixed region.

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81. A luminescent device according to claim 78, wherein a blocking material is doped in a portion of the mixed region, in which an energy difference between a highest occupied molecular orbit and a lowest unoccupied molecular orbit is large as compared with energy differences in the hole transporting material and the electron transporting material.

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82. A luminescent device according to claim 81, wherein the luminescent region is disposed nearer to the anode than the portion added the blocking material.

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83. A luminescent device according to claim 78, wherein the luminescent material presents luminance caused from a triplet excited state.

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84. A luminescent device according to claim 78, wherein the ratio of a mass of the hole transporting material to the total mass of the hole transporting material and the electron transporting material in the mixed region is 10 % or more and 90 % or less.

85. A luminescent device according to claim 78, wherein the mixed region has a thickness of 10 nm or more and 100 nm or less.

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86. A luminescent device according to claim 78, wherein the luminescent device is an electric appliance selected from the group consisting of a display device, a video camera, a digital camera, an image reproducing device, a mobile portable computer, a personal computer, a cellular phone, and an audio.

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87. A luminescent device comprising:  
an organic luminescent element comprising:

an anode;

a cathode;

a hole injecting region adjacent to the anode; and

an organic compound layer provided between the hole injecting region and the cathode, comprising a hole transporting region comprising a hole transporting material and an electron transporting region comprising an electron transporting material;

wherein a mixed region is provided between the hole transporting region and the  
5 electron transporting region, comprising the hole transporting material and the electron transporting material, and

wherein a luminescent region added a luminescent material is provided in the mixed region.

10 88. A luminescent device according to claim 87, wherein the mixed region comprises the hole transporting material and the ~~electron~~ transporting material at a constant ratio.

15 89. A luminescent device according to claim 87, wherein the luminescent region is a part of the mixed region.

20 90. A luminescent device according to claim 87, wherein a blocking material is doped in a portion of the mixed region, in which an energy difference between a highest occupied molecular orbit and a lowest unoccupied molecular orbit is large as compared with energy differences in the hole transporting material and the electron transporting material.

25 91. A luminescent device according to claim 90, wherein the luminescent region is disposed nearer to the anode than the portion added the blocking material.

92. A luminescent device according to claim 87, wherein the luminescent material presents luminance caused from a triplet excited state.

30 93. A luminescent device according to claim 87, wherein the ratio of a mass of the hole transporting material to the total mass of the hole transporting material and the electron transporting material in the mixed region is 10 % or more and 90 % or less.

94. A luminescent device according to claim 87, wherein the mixed region has a thickness of 10 nm or more and 100 nm or less.

95. A luminescent device according to claim 87, wherein the luminescent device is an electric appliance selected from the group consisting of a display device, a video camera, a digital camera, an image reproducing device, a mobile portable computer, a  
5 personal computer, a cellular phone, and an audio.

96. A luminescent device comprising:  
an organic luminescent element comprising:

10 an anode;  
a cathode;  
an electron injecting region adjacent to the cathode; and  
an organic compound layer provided between the electron injecting  
region and the cathode, comprising a hole transporting region comprising a hole  
transporting material and an electron transporting region comprising an electron  
15 transporting material;  
wherein a mixed region is provided between the hole transporting region and the  
electron transporting region, comprising the hole transporting material and the electron  
transporting material, and  
wherein a luminescent region added a luminescent material is provided in the  
20 mixed region.

97. A luminescent device according to claim 96, wherein the mixed region  
comprises the hole transporting material and the electron transporting material at a  
constant ratio.

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98. A luminescent device according to claim 96, wherein the luminescent region  
is a part of the mixed region.

99. A luminescent device according to claim 96, wherein a blocking material is  
30 doped in a portion of the mixed region, in which an energy difference between a highest  
occupied molecular orbit and a lowest unoccupied molecular orbit is large as compared  
with energy differences in the hole transporting material and the electron transporting  
material.

100. A luminescent device according to claim 99, wherein the luminescent region is disposed nearer to the anode than the portion added the blocking material.

101. A luminescent device according to claim 96, wherein the luminescent material presents luminance caused from a triplet excited state.

102. A luminescent device according to claim 96, wherein the ratio of a mass of the hole transporting material to the total mass of the hole transporting material and the electron transporting material in the mixed region is 10 % or more and 90 % or less.

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103. A luminescent device according to claim 96, wherein the mixed region has a thickness of 10 nm or more and 100 nm or less.

104. A luminescent device according to claim 96, wherein the luminescent device is an electric appliance selected from the group consisting of a display device, a video camera, a digital camera, an image reproducing device, a mobile portable computer, a personal computer, a cellular phone, and an audio.

105. A luminescent device comprising:  
an organic luminescent element comprising:

an anode;  
a cathode;  
a hole injecting region adjacent to the anode;  
an electron injecting region adjacent to the cathode; and  
an organic compound layer provided between the electron injecting region and the hole injecting region, comprising a hole transporting region comprising a hole transporting material and an electron transporting region comprising an electron transporting material;

wherein a mixed region is provided between the hole transporting region and the electron transporting region, comprising the hole transporting material and the electron transporting material, and

wherein a luminescent region added a luminescent material is provided in the mixed region.



106. A luminescent device according to claim 105, wherein the mixed region comprises the hole transporting material and the electron transporting material at a constant ratio.

5 107. A luminescent device according to claim 105, wherein the luminescent region is a part of the mixed region.

108. A luminescent device according to claim 105, wherein a blocking material is doped in a portion of the mixed region, in which an energy difference between a  
10 highest occupied molecular orbit and a lowest unoccupied molecular orbit is large as compared with energy differences in the hole transporting material and the electron transporting material.

109. A luminescent device according to claim 108, wherein the luminescent  
15 region is disposed nearer to the anode than the portion added the blocking material.

110. A luminescent device according to claim 105, wherein the luminescent material presents luminance caused from a triplet excited state.

20 111. A luminescent device according to claim 105, wherein the ratio of a mass of the hole transporting material to the total mass of the hole transporting material and the electron transporting material in the mixed region is 10 % or more and 90 % or less.

112. A luminescent device according to claim 105, wherein the mixed region has  
25 a thickness of 10 nm or more and 100 nm or less.

113. A luminescent device according to claim 105, wherein the luminescent device is an electric appliance selected from the group consisting of a display device, a video camera, a digital camera, an image reproducing device, a mobile portable computer,  
30 a personal computer, a cellular phone, and an audio.

114. A luminescent device comprising:  
an organic luminescent element comprising:  
an anode;

a cathode;

a first mixed region adjacent to the anode, comprising a hole injecting material and a hole transporting material;

a second mixed region adjacent to the cathode, comprising an electron injecting material and an electron transporting material; and

a third mixed region provided between the first mixed region and the second mixed region, comprising the hole transporting material and the electron transporting material.

10 115. A luminescent device according to claim 114, wherein there is a concentration gradient in the first mixed region that a concentration of the hole transporting material is decreased toward the third region from the anode and a concentration of the hole injecting material is increased toward the third region from the anode.

15 116. A luminescent device according to claim 114, wherein there is a concentration gradient in the second region that a concentration of the electron transporting material is increased toward the third region from the cathode and a concentration of the electron injecting material is decreased toward the third region from  
20 the cathode.

117. A luminescent device according to claim 114, wherein there is a concentration gradient in the third region that a concentration of the electron transporting material is decreased toward the first region from the second region and a concentration  
25 of the hole transporting material is increased toward the first region from the second region.

118. A luminescent device according to claim 114, wherein a luminescent material is doped in a portion of the third region.

30 119. A luminescent device according to claim 118, wherein the luminescent material is a triplet luminescent diode.

120. A luminescent device according to claim 118, wherein the luminescent

device is an electric appliance selected from the group consisting of a display device, a video camera, a digital camera, an image reproducing device, a mobile portable computer, a personal computer, a cellular phone, and an audio.

5 121. A luminescent device comprising:

an organic luminescent element comprising:

an anode;

a cathode;

10 a first mixed region contiguous to the anode, comprising a hole injecting material and a hole transporting material;

a second mixed region contiguous to the first region, comprising the hole transporting material and a host material;

a third mixed region contiguous to the second mixed region, comprising the host material and a blocking material; and

15 a fourth mixed region provided between the third mixed region and the cathode, comprising the blocking material and an electron injecting material.

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20 122. A luminescent device according to claim 121, wherein there is a concentration gradient in the first region that a concentration of the hole injecting material is decreased toward the second region from the anode and a concentration of the hole transporting material is increased toward the second region from the anode.

25 123. A luminescent device according to claim 121, wherein there is a concentration gradient in the second region that a concentration of the hole transporting material is decreased toward the third region from the first region and a concentration of the host material is increased toward the third region from the first region.

30 124. A luminescent device according to claim 121, wherein there is a concentration gradient in the third region that a concentration of the host material is decreased toward the fourth region from the second region and a concentration of the blocking material is increased toward the fourth region from the second region.

125. A luminescent device according to claim 121, wherein there is a concentration gradient in the fourth region that a concentration of the blocking material is

decreased toward the cathode from the third region and a concentration of the electron injecting material is increased toward the cathode from the third region.

126. A luminescent device according to claim 121, wherein a luminescent  
5 material is doped in a portion of both second region and third region.

127. A luminescent device according to claim 126, wherein the luminescent material is a triplet luminescent diode.

10 128. A luminescent device according to claim 121, wherein the blocking material is an electron transporting material.

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